8. RESOURCES AND OPERATIONS

8.1 Available Resources

Funds and personnel beyond those requested in this proposal, necessary for the operation of the injector, the storage ring, and OK-4 FEL during the initial period of development of the HIGS facility will be provided by the DFELL Laboratory, the Triangle Universities Nuclear Laboratory, and Duke University. The resources of these laboratories which will be available to this project include:

- Four 10"x10" NaI detectors, plastic anticoincidence shields, and supporting electronics
- Two 130-140% HPGe detectors and support systems
- Four 60% HPGe detectors and electronics
- Array of silicon surface barrier detectors, chambers and electronics
- Array of calibrated neutron detectors with PSD
- Pumping stations and support equipment
- Off-line computing facilities at TUNL and DFELL
- PC and MCA data acquisition devices
- Target fabrication facilities
- Library and Shop services

Faculty, postdoctoral fellows and students of both laboratories will be involved in various aspects of this project at various stages. Technical support from DFELL and TUNL technical support personnel will be available on a part-time shared basis.

The project will be overseen by the Directors of TUNL and the DFELL. Dr. H. R. Weller will be responsible for measuring the characteristics of the $\gamma$-ray beams, and for co-ordinating the nuclear physics experimental program. It is expected that he and the TUNL Radiative Capture Group, working with outside collaborators, will initiate the first nuclear physics experiments using the HIGS facility. This group presently consists of two research associates and five graduate students, as well as three-additional faculty collaborators: Dr. D.R. Tilley of North Carolina State University, and Drs. R. M. Prior and M. Spraker (as of August 15, 1997) of North Georgia College and State University. Members of the TUNL NTOF group (Drs. W. Tornow, C.R. Howell and D. Gonzalez Trotter) will be responsible for neutron detection in these initial experiments. Dr. C.R. Howell will also be responsible for the data acquisition system at the HIGS facility.

Dr. V. Litvinenko will direct the development of the high intensity $\gamma$-ray source (HIGS). He presently leads the storage ring and the OK-4 FEL projects. His research group includes Dr. B.
Burnham, Dr. I. Pinayev, Dr. Y. Wu and graduate student S. H. Park. This group has demonstrated the successful near UV lasing and production of the first backscattered γ-ray beam at 12.2 MeV from the OK-4 FEL, and is presently pursuing the OK-4 FEL lasing in the deep UV. Dr. Litvinenko will supervise the ring modifications, the extension of the FEL into the deep UV region and the construction of the booster-injector system. Dr. Y. Wu will be responsible for the design, acquisition and commissioning of the booster-injector system described in this proposal. Dr. P. O'Shea will be responsible for the operation of the existing linac-injector prior to commissioning of the booster-injector.

A one-page CV of the individuals mentioned above, as well as other TUNL and DFELL faculty members who will be involved in this project, is presented in Attachment C.

8.1.1 Nuclear Physics Manpower

A number of TUNL physicists have already made a commitment to this project. As the project develops, it is expected that more will join the project. A list of those who have already committed, along with the special area of expertise to which they will make their initial contribution, is presented below. One page CVs are presented in Attachment C.

Dr. A. E. Champagne--Professor of Physics, University of North Carolina at Chapel Hill.

Dr. Champagne is an expert in the field of nuclear astrophysics. His interest in HIGS will focus on the use of intense low energy γ rays as a means for measuring reactions of astrophysical interest. His expertise in various detector applications, such as magnetic spectrometers and γ-ray detectors, will be applied to developments at the HIGS installation.

Dr. C. Gould--Professor of Physics, North Carolina State University.

Dr. Gould has been intimately involved in symmetry experiments at TUNL which utilize polarized beams and targets. He is especially interested in pursuing similar experiments at HIGS, and will play a key role in instrumenting HIGS with polarized target capabilities.

Dr. D. Haase--Professor of Physics, North Carolina State University.

Dr. Haase is a low-temperature physicist who has been responsible for the design, construction and use of polarized targets at TUNL. He is interested in developing a polarized target facility for HIGS experiments, as described in this proposal.

Dr. F. Moore--Assistant Professor of Physics, North Carolina State University
Dr. Moore has done most of his work on nuclear structure physics using the techniques of gamma-ray spectroscopy at ANL. His primary interests are in the study of superdeformed bands and chaos in nuclei. He has extensive experience with high resolution Ge gamma-ray detectors, most recently in the construction of a Compton suppressed Ge detector system for the High Resolution Laboratory at TUNL.

Dr. N. R. Roberson--Professor of Physics, Duke University, and former (until July, 1996) Director of TUNL.

Dr. Roberson has considerable experience in accelerator operation, beam line design and construction, and installation and use of polarized targets. His recent work has involved the study of the N-N force by scattering polarized neutrons from polarized protons, as well as studies of time reversal invariance. Dr. Roberson is interested in helping to develop the experiments which involve polarized $\gamma$ rays on a polarized proton target at HIGS.

**Outside Collaborators:**

A great deal of help in the work done to date in developing this proposal has been received from Dr. T. S. Carman of the Livermore National Laboratory and Dr. Blaine Norum of the Physics Department at the University of Virginia. Dr. Norum has made frequent visits to TUNL and has been involved in all phases of the computer studies of the properties of the $\gamma$-ray beams as well as the background measurements of the bremsstrahlung radiation. Dr. Norum is very interested in continuing to collaborate on the development of this facility and its use in nuclear physics experiments. He is, for example, the prime mover behind both the DHG sum rule measurements on the deuteron and the study of delta excitations in finite nuclei. In the future he and his U. Va. collaborators are anxious to help in the development of the beam, target and detectors needed for the DHG-sum rule experiment on the deuteron. They are also looking forward to participating in the installation, commisioning and utilization of the NMS. His University of Virginia colleague, Dr. D. Pocanic, who has considerable experience and technical resources in this area, has also expressed a strong interest in helping with this project.

The research group at the University of Saskatchewan has been deeply involved in studies of photopion cross-section measurements near threshold. This group is extremely interested in collaborating in the HIGS project. The high-intensity polarized beam will be ideal for the next generation of photopion threshold measurements. Their motivation and their CV’s are given in Attachment G.

Discussions with physicists at other institutions have indicated that there is a serious and broad-based interest in the $\gamma$-ray beam being promised by the HIGS facility. A large number of
people have indicated an interest. Several individuals have stated that they are presently willing to commit to working with TUNL and DFELL researchers in the early stages of this project, in order to help implement the physics program and assure its success. A list of some of these physicists is given below; their CV's are included in Attachment C. A more complete list of the Nuclear Physics Manpower presently available for the HIGS project is given in Attachment H. This list is expected to grow when the beam comes on-line.

Dr. J. Calarco- Professor of Physics, University of New Hampshire  
Dr. J. Feldman- Assistant Professor, George Washington University  
Dr. R. V.F. Janssens-Senior Scientist, Physics Division, Argonne National Laboratory  
Dr. T. L. Khoo-Senior Scientist, Physics Division, Argonne National Laboratory  
Dr. L. Kramer- Assistant Professor, Florida International University  
Dr. B. Norum- Professor of Physics, University of Virginia  
Dr. J. Templon- Assistant Professor, University of Georgia

We are planning to organize a workshop designed to organize outside users and to prioritize the experimental program as soon as support for this proposal is indicated to us.

**Theoretical Support:**

We have been fortunate in having had the help and support of Dr. Ulf Meißner in preparing this proposal. Dr. Meißner visited us on several occasions, and besides working on the content of the proposal, presented a series of lectures on Chiral Perturbation Theory. Visits by Dr. A. I. L'vov and Henryk Witala have also been quite beneficial.

Several local theorists have also expressed a strong interest in several aspects of the physics which we hope to study with the HIGS facility. A list of the internal and external theorists who have indicated their interest in helping to guide and interpret future HIGS experiments is given below:

Dr. A. I. L'vov- Lebedev Institute, Moscow  
Dr. U. Meißner- University of Bonn, Germany  
Dr. B. Müller- Duke University  
Dr. R. Schiavilla- Old Dominion University and TJNAF  
Dr. R. Springer- Duke University  
Dr. H. Witala- Jagellonian University, Cracow, Poland; and TUNL
8.2 Additional Personnel and Operations

The present proposal requests funding for one research associate (FEL), one technician and one engineer. These three personnel will be dedicated to the project and will supplement the current DFELL staff so that the upgrade of the electron injector and the modifications to the ring and beam optics can proceed in an efficient manner, and the project can be completed within the three-year budget period without impacting the Medical FEL program. A second research associate (TUNL) is included to assist the TUNL staff in the development of the nuclear physics experimental facilities (see Attachment B).

An agreement between TUNL and the DFELL allocates 1000 hours of HIGS beam time per year to be used for nuclear physics experiments. This agreement commences when this proposal is funded. In order for it to continue beyond the three year proposal period, it will be necessary for the three dedicated personnel discussed above to be continued and funded as part of the TUNL grant. They will be available to the DFELL management to support the operations of the facility for the extra 1000 hours per year. In addition, through a special agreement with Duke University and the Department of Physics, the overhead generated by this proposal will cover the extra operating costs (electricity for example.) These agreements will be valid as long as TUNL support, in the form of the three dedicated personnel described above, is provided (see Attachment B).